Space Weather Technical Forecast

Issued on Sunday, 11 September 2022 at 01:20 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Disappearing filament awaiting imagery. Active electron fluence. Possible minor geomagnetic activity midweek.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Low over the past 24 hours, with X-ray activity at GOES16 and 17 again displaying occasional low-end C-class flares. These flares peaked with a C2.6 from AR3100 at 10/1119UTC, with this spot seeing growth in its leading penumbral spot to finish the period as a Cao/Beta. This was one of eight sunspot groups on the disc in the period, with two main other regions of note being AR3098 and newly-numbered AR3101. Both of these groups showed growth in the period, with AR3098 proliferating across a wide latitudinal span to become a Cri/Beta, while AR3101 grew rapidly from plage in the northwest to become Bxi/Beta. All of the remaining regions were either (apparently) magnetically unipolar, else simple or decaying dipoles.

There remain many large filaments scattered across the solar disc. One such filament disappeared from the northern central solar hemisphere around 10/1930UTC, as shown in Cerro Tololo H-alpha imagery. This event is not yet visible on coronagraphs, however could well have an Earth-directed component should it have the impetus to leave the immediate solar environment. The only event to appear on coronagraphs at the time of writing was a low-latitude southeastern quadrant dimming, with this analysed and not expected to affect Earth. In the UTC evening, a high latitude northwest limb prominence also became visible, however Earth-based effects are not expected from this location.

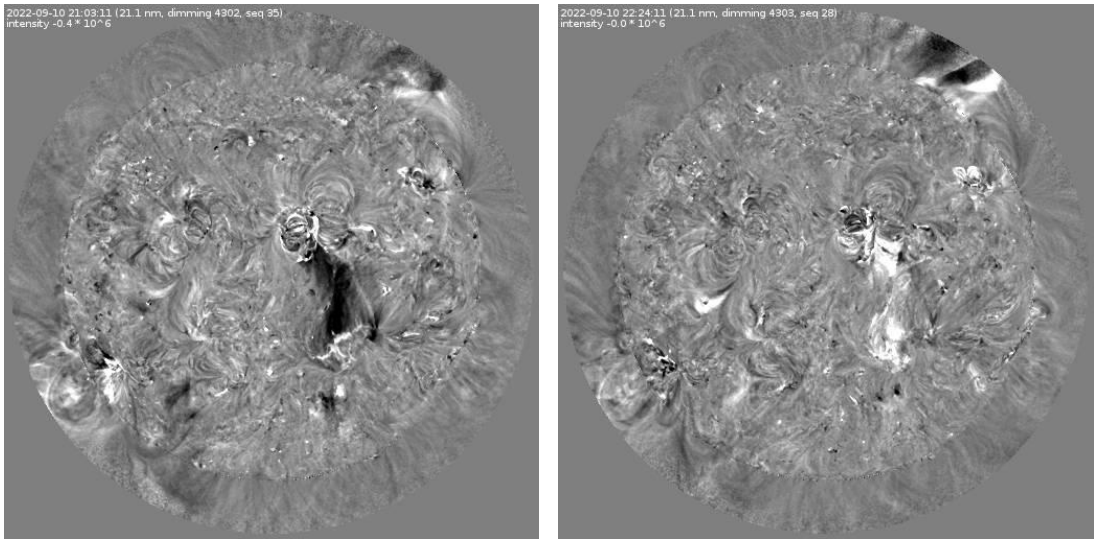

Figure 0: Time-integrated AIA 211 imagery of centre-disc dimming from a disappeariung filament (left) and northwestern prominence (right). Any ejecta from the filament is not yet visible on coronagraphs, but will be analysed should it appear. Image processing courtesy of SIDC ROB.

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All considered, no new Coronal Mass Ejections (CMEs) have been confirmed, however ejecta from the 10/1930UTC event is awaited for analysis.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was indicative of a slight resurgence of a fast wind regime, perhaps indicating CH20/+ segueing into CH24/+.

The solar wind speed rose over the 24 hours through Slightly Elevated levels: from near 400km/s to approach 500 by the end of the period. The solar wind density was within long-term background levels in single figures ppcc, while the IMF peaked at 7nT. The north-south component varied between +5 and -6nT, but was often anti-aligned with the Earth's field to greater effect. The phi angle was mainly away from the Sun (positive), but with a little more variability than in recent days.

The net result of the above solar wind measures was provisionally mainly Unsettled, with peak Kp of 3+ in the 15-18UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, was slightly above its characteristic background trace, peaking near 1pfu before decreasing slightly by the end of the 24 hours.

The high energy electron flux (greater than 2 MeV) was persistently High, peaking at 1.55e4 pfu at 10/1410UTC. The 24-hour electron fluence remained above Active (1e8 integrated pfu) with a roughly level trend, and a 11/0001UTC observed value of 3.72e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low, but with a slightly increased Slight Chance of rising to Moderate with isolated M-class flares, mainly as a result of the potential return of Ex-AR3088 over the southeastern limb in the first 36 hours.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast carries low confidence. The tail of CH24/+ should give a Slight Chance of Active intervals at first, soon fading to leave mainly Quiet conditions into the start of the new working week. Confidence falls further from later Tuesday 13 September, whereupon there is a risk of CH22/- and the 09 September CME arriving, with both more likely midweek.

The above forecast does not include any contribution from the disappearing filament seen 10/1930UTC, with this yet to be analysed.

Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels.

The high energy (greater than 2 MeV) electron flux is currently at High levels, and is Likely to remain so until midweek UTC, whereupon a combination of coronal hole 22 and perhaps the 09 September CME may act to redistribute electrons. The corresponding 24-hour fluence is expected to see only a gradual fall at first in the period, but likely remaining above Active (1e8 integrated pfu) until midweek.

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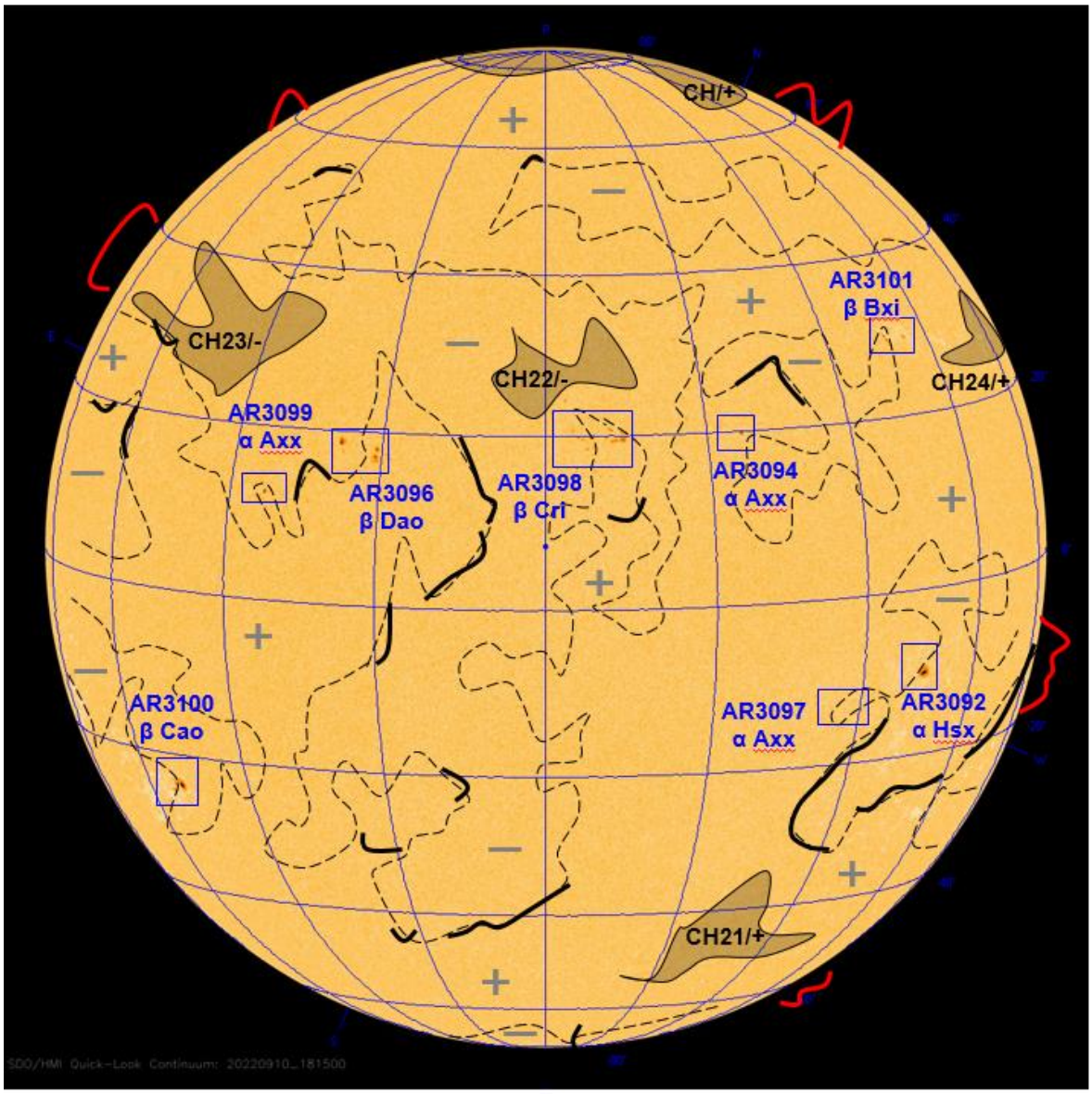
Figure 1. Solar Analysis Valid 10/1815UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The geomagnetic forecast for the coming four-day period carries relatively low confidence, especially into the second half. The current fast wind has lasted longer than anticipated from CH20/+, and it seems likely that the faint CH24/+ is extending the long tail of activity. This should ease into the new working week UTC, with a lull then expected for a time.

The second half of the forecast period is especially low confidence, with the weak remnant successor to a very large coronal hole from last rotation (the now faint and fragmentary CH22/-) perhaps affecting Earth on Wednesday 14 September. On its own, this is not likely to be particularly potent due to its polarity and tenuous appearance, however it may be bolstered by a slow CME from 09 September. The source of this CME is not immediately apparent, but may be filament-related as there is a gap in H-alpha capability around UTC dawns at present as Udaipur is in monsoon season.

There is then the possibility of further contribution from the as yet unassessed centre-disc filament eruption of the UTC evening of 10 September. This will be investigated once coronagraph imagery becomes available.

Residual influence from CH20/+ and CH24/+ should reduce through day one, Sunday 11 September: Unsettled with an initial Slight Chance of isolated Active intervals, trending to become predominantly Quiet into Monday. There is then an increasing Slight Chance of Minor Storm G1 later in the four days, peaking on Wednesday 14 September.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/0400UTC	Partial(?)	Unknown	Unknown	230km/s	14/0900UTC	Uncertain origin, visible in coronagraphs as faint emission mainly north and west of Earth. Low confidence

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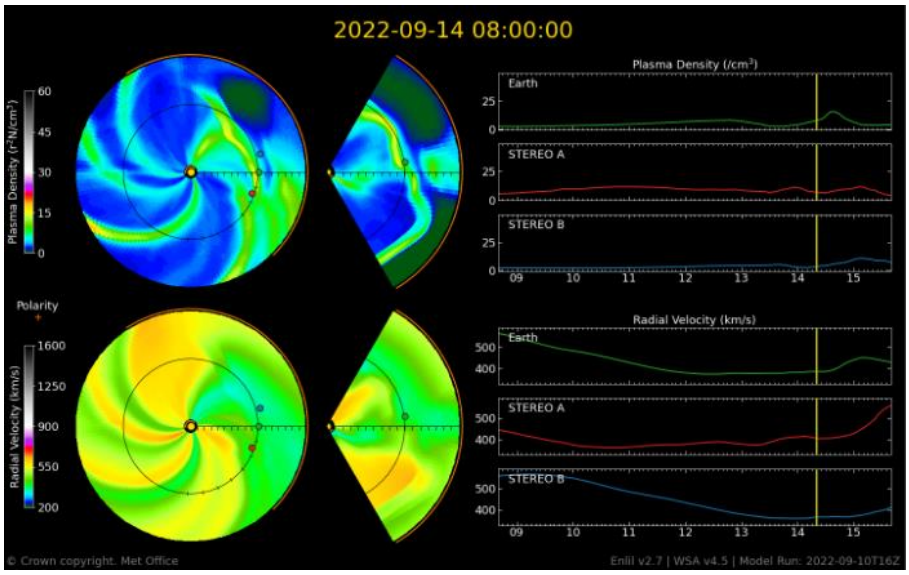
Figure 2: Latest MOSWOC Enlil run, showing glancing blow from the 09 September CME around 09UTC on Wednesday 14 September. This feature is of low confidence, but may be bolstered slightly by a concurrent fast wind from minor CH22/-.



Radio Blackouts - X-Ray Flares:

There are currently eight numbered regions on the solar disc, however these are all relatively subdued in terms of both activity and potential flare risk, with recent days only seeing peak X-ray flux in low C-class.

This quiet tendency is becoming less likely to continue however, largely as a result of potential returning regions into the new week. The survival of several spot groups is suggested by both far-side seismographs and STEREO A EUVI 195 imagery near the eastern limb. Ex-AR3088 is due to return over the limb on day two, Monday 12 September, and was a notable region on its last-day status with numerous M-flares prior to this. The rear and east-directed CME of 08 September could also have emanated from this region. This group brings a slightly increased potential for flaring from 11 September onward, as any associated looping becomes visible. This is low confidence however, as it is uncertain how much this region has evolved during its far-side transit.

All considered, the chances of M-class flares have been revised upwards slightly relative to the recent past, and the coming UTC week is likely to prove more eventful than the previous.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

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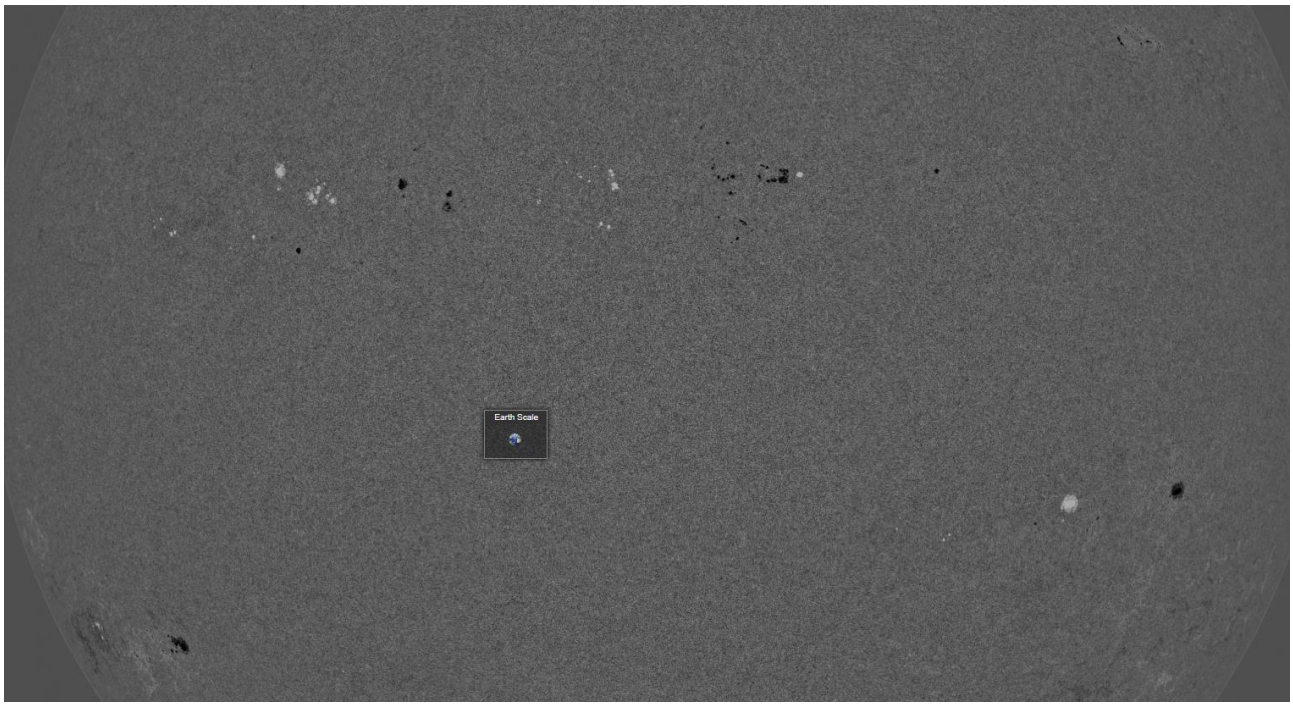
Figure 3: Helioviewer.org-generated difference imagery of HMIIF, showing 24-hour changes in sunspot groups between 09/2345UTC (white) and 10/2345UTC. Main changes have been in AR3100 (lower left); AR3098 (upper centre); and AR3101 (upper right).



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) observed by GOES-16 remains near Background values, but with a very slight enhancement evident that appears to have now peaked near 1pfu.

The source of this slight increase may be tied to one of the rearward-directed limb CMEs of 08 September, with a relatively soft onset and rise seen. Whatever the source, repeats of such activity are not considered likely, and little change is expected given the lack of complex regions in geoeffective locations.

Radiation Storms	**Level (cm^{-2} sr^{-1} s^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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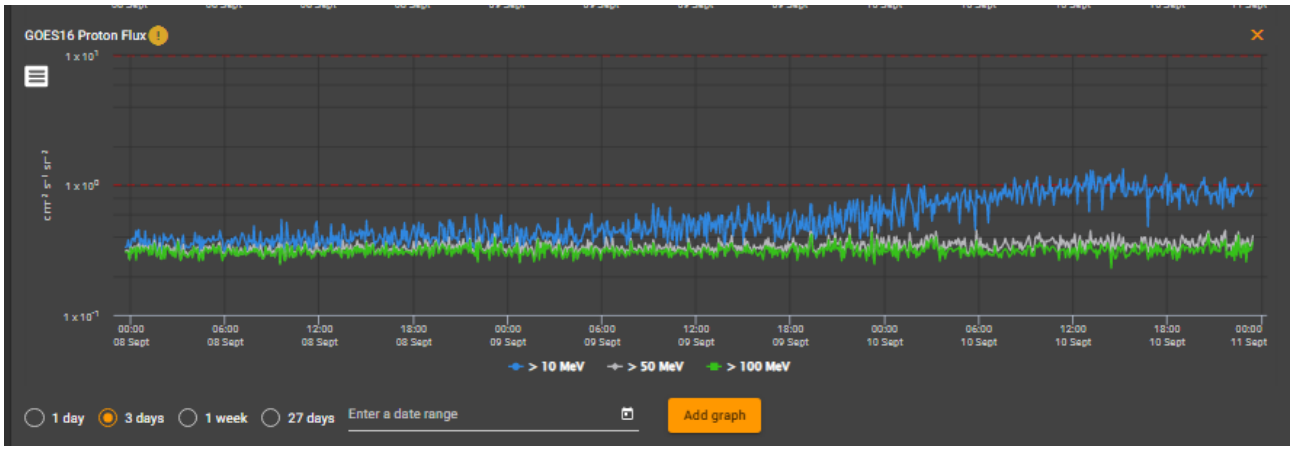
Figure 4: Past three days in greater than 10MeV protons (blue trace), showing soft response to probable far-sided CME activity over the period. This enhancement appears to have peaked and is not expected to be repeated.



High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electrons have shown a significant response over recent days to the long-lasting connection to coronal hole 20 fast wind, now perhaps succeeded by CH24/+. Persistent High flux levels have been observed by GOES16, with only an erratic decay of peak values. The levels are expected to very gradually decline through the first half of the period, perhaps falling more sharply with the possible advent of CH22/- and a weak CME from 10 September on day four, Wednesday 14 September.

The associated 24-hour fluence levels are expected to see a gradual fall through the period, likely persisting above the Active threshold throughout, but with an increasing chance of falling below midweek UTC.

MOSWOC REFM is considered to give reasonable guidance for the overall trend through the period, but the presence of at least one transient should render this forecast less reliable around the middle of the coming week.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	90	70	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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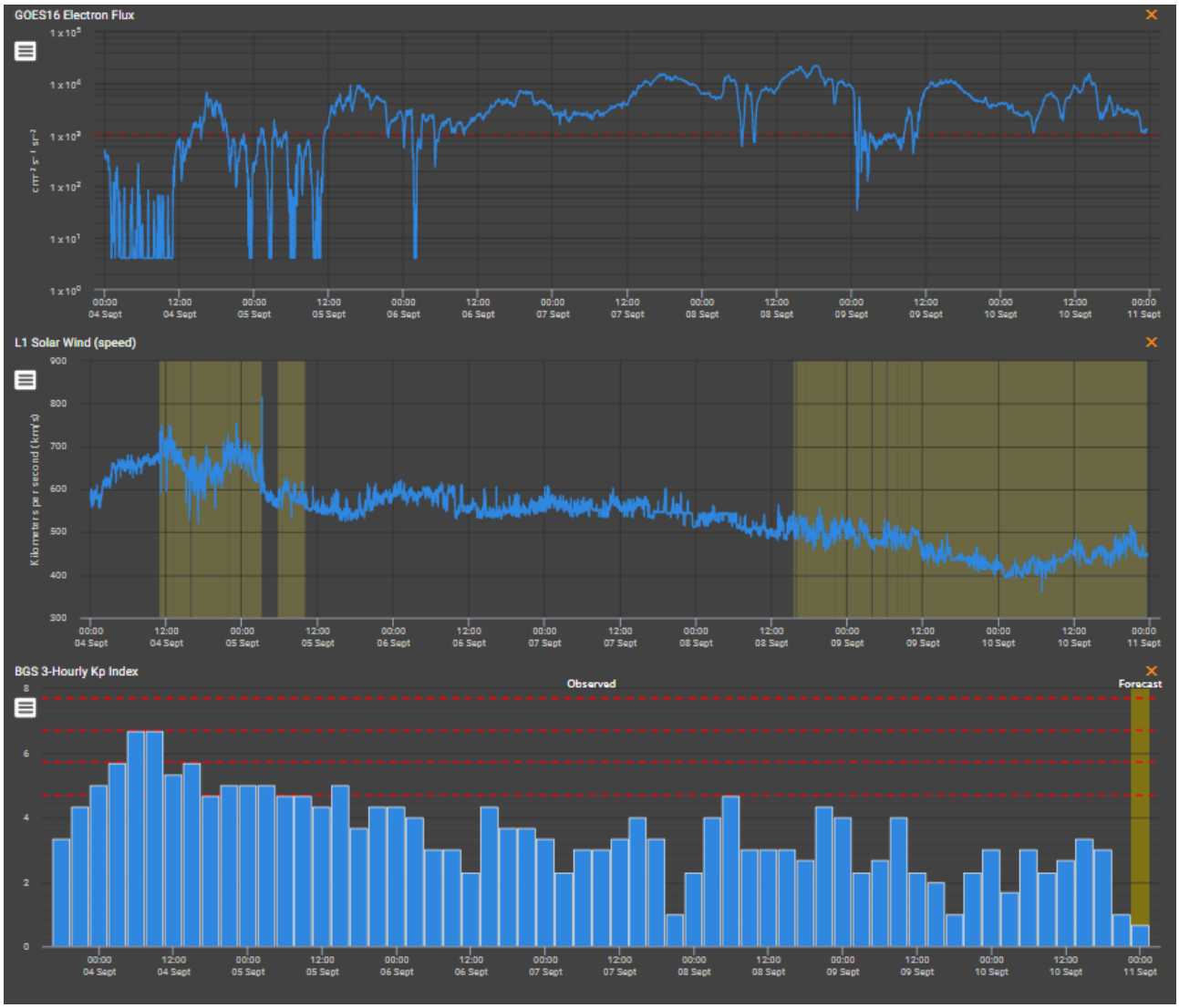
Figure 5: Past week in greater than 2MeV electrons (top); L1 solar wind as measured by DSCOVR and ACE (the latter in yellow shading); BGS-recorded geomagnetic activity. The current diurnal oscialltion should very gradually wane into the new week, probably accelerating after the arrival of any CH22 fast wind and CME(s) midweek.



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